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Question Paper Code : 51847

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Mechanical Engineering

ME 2204/CE 3213/ME 34/CE 1208/080180007/IE 41/10122 ME 305 – FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering, Automobile Engineering, Production Engineering, Mechatronics Engineering, Mechanical and Automation Engineering and Fourth Semester Manufacturing Engineering, Industrial Engineering and Industrial Engineering and Management)

(Regulations 2008/2010)

(Common to PTME 2204/10122 ME 305 – Fluid Mechanics and Machinery for B.E. (Part-Time) Third Semester – Mechanical Engineering and Management)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. State the conditions under which uniform and non-uniform flows are produced.
2. What is an impulse-momentum equation ?
3. State the equation of discharge of water through an open channel.
4. How does the roughness of channel affect the Chezy's constant ?
5. State the application of dimensional numbers and mention its significance.
6. What is the effect of scale effect and distorted model in dimensional analysis ?
7. Francis turbine is not used as a high head turbine ?
8. In what respects outward flow reaction turbine differs from inward flow reaction turbine ? Which one is better and why ?
9. What is cavitation in pump ? How it can be avoided ?
10. List importance of air vessels in reciprocating pump.

PART – B (5 × 16 = 80 Marks)

11. (a) An incompressible fluid flows downward through a vertical cylindrical pipe under the action of gravity. The flow is fully developed and laminar. Use the Navier-Strokes equations to derive an expression for the flow rate for the case of zero pressure gradients along the pipe. **(16)**

OR

(b) A thin layer of liquid of constant thickness flow down an inclined plate such that the only velocity component is parallel to the plate. Use the Navier-Strokes equations to determine the relationship between the thickness of the layer and the flow rate per unit width. Assume a steady, laminar, and uniform flow. Also assume that air resistance is negligible. **(16)**

12. (a) (i) Derive an expression for the depth of paraboloid formed by the surface of a liquid contained in a cylindrical tank which is rotated at a constant angular velocity w about its vertical axis. **(6)**

(ii) 250 litres/sec., of water is flowing in a pipe having diameter of 300mm. If the pipe is bent by 135°, find the magnitude and direction of the resultant force on the bend. The pressure of the water flowing is 400kN/m^2. Take specific weight of water as 9.81kN/m^3. **(10)**

OR

(b) (i) Enumerate the different laws on which models are designed for dynamic similarity. Where are they used ? **(6)**

(ii) Water having a coefficient of kinematic viscosity of 1.12×10^{-6} m^2/s and a mass density of 1 mg/m^3 flows at a mean speed of 1.75m/s through a 75mm diameter pipe line. What corresponding volumetric rate (measured at atmospheric pressure) of air flow through this pipeline would give rise to essentially similar dynamical flow conditions and why would this be so ? Air may be assured to have a coefficient of kinematic viscosity of 14.7×10^{-6} m^2/s and a mass density of 1.23 kg/m^3 Determine for each fluid, the pressure drop which would occur in 10m length of this pipeline. Take f = 0.010 (Darcy's friction factor) for both fluids. **(10)**

13. (a) An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2500 litres/sec. through a 1.2 m diameter pipe. Tests were conducted on a 12cm diameter pipe using water at 20°C. If the viscosity water at 20°C is 0.01 poise, find :

(i) Velocity of flow in the model **(6)**

(ii) Rate of flow in the model **(10)**

OR

(b) The model of tidal channel in a coastline study is scaled to 1/100 of actual size. Fresh water is to be used in place of sea water in the model. Assuming the Reynolds number must be matched, what model velocity is needed to ensure dynamic viscosity ? Will similarly also be achieved for free surface effects related to the Weber and Froude numbers ? In your calculations, note that the appropriate velocity and length scales for the actual tidal channel are V = 0.5 m/s and L = 10 m, respectively. **(16)**

14. (a) A Pelton wheel has to be designed for the following data :

HP to be developed	= 8500
Net head available	= 280 m
RPM	= 650
Ratio of jet diameter to wheel diameter	= 1/9
Mechanical efficiency	= 88%

Find the number of jets, diameter of jet, diameter of wheel and quantity of water required. **(16)**

OR

(b) A Francis turbine working under a head of 20 m is supplied with 1.5 m^3/sec of water. Wheel diameter at the entrance and exit are 1 m and 0.6 m respectively. It is developing 300 HP at 300 rpm. Velocity of water at exit is 3 m/sec. Assuming wheel width constant, find (i) theoretical hydraulic efficiency (ii) actual efficiency (iii) suitable angles of guide vanes and runner vanes at inlet. **(16)**

15. (a) A centrifugal pump has a head discharge characteristic given by $H = 35 - 2200\ Q^2$, where H is head developed by pump in 'm' and Q is discharge in m^3/sec. The pump is to deliver a discharge against a static head of 12 m. The suction pipe is 15 cm diameter and 20 m long with an f value of 0.018. The delivery pipe is 20 cm diameter and 40 m long with an f value 0.02. Calculate the head and discharge delivered by the pump. If the overall efficiency is 0.7, calculate the power supplied. **(16)**

OR

(b) A single acting reciprocating pump has following dimensions :

Piston diameter	= 25 cm
Stroke	= 35 cm
Speed	= 40 rpm
Suction head	= 4.5 m
Delivery head	= 18 m
Suction pipe: Diameter = 15 cm; length	= 9 m
Delivery pipe: Diameter =12 cm; length	= 32 m
Coefficient of friction	= 0.028
Atmospheric pressure	= 10.3 m of water

Find (i) pressure head on the piston at the beginning, middle and end of the suction and delivery strokes, (ii) HP required to driving the pump. **(16)**
